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Investigation of the impact of sonar transmission on fisheries and habitat in the U.S. Navy's USWTR: Summary of stakeholder concerns and appropriate research areas

by

Dr. Andrew Read and Elliott Hazen

September 2007

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Public comments responding to the Draft Environmental Impact Statement (October 2005) for the proposed Undersea Warfare Training Range (USWTR) off North Carolina were analyzed to provide a comprehensive view of stakeholder concerns. Three main areas of public concern—short and long term effects on fish from mid-frequency sonar operations, displacement of fishermen during training exercises, and habitat modification/destruction—were identified. Research areas that might address these concerns were also identified and examined. Finally, an abridged table of specific public comments is included.

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Summary of stakeholder concerns and appropriate research areas

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February 28th, 2007

Summary of stakeholder concerns

To provide a comprehensive view of stakeholder concerns, we analyzed public comments that responded to the USWTR Draft Environmental Impact Statement (DEIS) from October, 2005. These comments were flagged, condensed, and compared to the summary we received from Keith Jenkins, Naval Facilities Engineering Command, Atlantic (Appendix A).

A total of 325 comments mentioned fish, fishermen or fisheries, essential hard bottom, and discarded waste. A subset of these comments (61) mentioned acoustic concerns about the same subjects. The numbers of each comment type are summarized in Table 1 with a detailed summary of our findings below.

Table 1. Total number of comments that focused on fish, fisheries, habitat, and discarded waste. The second row shows the number of comments that included acoustic concerns.

	Fish	**Fisheries**	**Bottom Habitat and Waste**
All Concerns	133	120	55
Acoustic Concerns	60	6	2

There were three main areas of public concern about fish and fisheries in the proposed USWTR. These are listed below, in order of the number of public comments on each topic. We present these concerns without any assessment of their validity. Many respondents noted that the draft EIS did not adequately incorporate existing research but also pointed out that further research is necessary to adequately address acoustic impacts.

1. Short and long- term effects on fish from mid-frequency sonar operations.

These concerns included effects on catch rates, spawning choruses, migratory behavior, hearing loss, direct mortality, and on larval stages.

Catch Rates. Several fishermen mentioned anecdotal accounts of fish-finders reducing catch rates of large, valuable pelagic species (see list below). The comments noted that the DEIS did not identify plans to address the effects of mid-frequency sonar on these species.

Spawning Choruses. There are many soniforous (sound-producing) fish species in NC waters and several comments noted that testing involving mid-frequency sonar could mask (drown out) mating choruses. Such an adverse effect on reproductive behavior would have obvious deleterious population-level effects.

Distribution & Migratory Behavior. In addition, concerns were expressed that migratory fish would avoid waters surrounding the USWTR, resulting in large-scale ecosystem and fishery impacts. Some comments expressed the view that such effects may occur at large spatial scales, while others were concerned that distributional or behavioral changes of fish could affect fishing quality in key fishing grounds within the USWTR (e.g. Grouper hole and

Swansboro hole).

Physiological Effects & Direct Mortality. Long term hearing loss or direct mortality have been observed in fishes exposed to loud sounds (Turnpenny and Nedwell 1994), but there is no mention of this past research or plans for future research in this area on the effects of exposure to mid-frequency sonars. Some respondents noted that larval stages could be particularly sensitive to such sounds.

Many comments noted that if the use of mid-frequency sonars have adverse effects on fishes, there could be important economic effects on tourism (e.g. SCUBA diving), recreational, and commercial fisheries.

Species or families of fish mentioned specifically in the public comments are listed below.

a. Sciaenidae spp.
b. Caranigidae spp.
c. Scombridae spp.
d. Scleanidae spp.
e. Bluefin and Yellowfin Tuna (Thunnus spp.)
f. Mahi Mahi (Coryphaena hippurus)
g. Wahoo (Acanthocybium solandri)
h. Billfish, Marlin (Makaira spp.)
i. Snapper (Lutjanus spp.)
j. Snowy Grouper (Acanthocybium solandri)
k. Striped Mullet (Mugil cephalus)
l. Menhaden and Herring (Clupeids)
m. Sharks, Rays, and Skates (Elasmobranchii)

These four primary areas of concern will form the basis for our workshop on sonar and fisheries in mid-April.

We will also gather further information from local fishermen and resource managers before the workshop in a series of informal meetings and discussions. We believe that this additional information will help us in formulating and refining research priorities.

The following two categories of concern were raised frequently in public comments and need consideration by the Navy. We consider both areas to be outside the scope of our workshop.

2. **Displacement of fishermen during training exercises.** Other than direct effects on fish, the primary concern of many coastal stakeholders (particularly recreational and commercial fishermen) is be that they will be required to leave the area during training exercises.

3. **Habitat modification or destruction.** Concerns were expressed about effects during construction of USWTR as well as potential effects of discarded materials (sonobuoys, XBTs, parachutes, etc.) during training operations. Many comments noted that hard bottom habitat is important fish habitat and that such areas could be adversely affected during both construction and active operation.

Potential research areas

We consulted the literature to identify past research on top predator and forage fish that has examined similar issues. The brief list below identifies some research areas that hold promise to address the four areas of concern identified above. The workshop to be held in Durham this April will prioritize and flesh out these research needs.

Ex situ experiments

Threshold experiments should be conducted to determine the sensitivity of species of interest to mid-frequency sonar (e.g. Mann et al. 2001, Mann et al. 2005). Past studies have investigated the frequency range of hearing in a variety of fish species, with some research focusing specifically on ultrasonic sound. In these experiments, fish are typically held in small tanks and exposed to sounds that are varied systematically in frequency and/or intensity. The sensitivity of a fish to each sound is monitored using electrodes that measure auditory brainstem response (ABR). These studies have established audiograms (systematic evaluations of sensitivity to a variety of frequencies) but have not focused on lethal effects or on long-term effects of anthropogenic sound.

Similar research on species of concern in North Carolina waters is necessary, although some public comments expressed concern with translating the results from lab experiments to the field without suitable calibration.

Potential categories of *ex situ* research are listed below.

- Measurements of behavioral response to mid-frequency sonar (e.g. Mann et al. 2001, Mann et al. 2005). These tests should be extended to species of interest within the proposed USWTR.

- The potential for temporary threshold shifts (TTS) or permanent threshold shifts (PTS). To date, studies have been very limited in this respect. TTS was observed in fathead minnows (Pimephales promelas) with simulated engine noise at 142 dB (Scholik and Yan 2002) while a PTS occurred in oscars (Astronotus ocellatus) exposed to low-frequency sound (60-300 Hz) at varying sound levels (100, 140, and 180 dB, Hastings et al. 1996).

- The potential for long-term behavioral modifications which could lead to changes in distribution or migratory behavior. Very little, if any, research has examined such effects ex situ.

In situ experiments:

These objectives could also be addressed by studying field behavioral responses in species of interest within the proposed USWTR. For example, Eularian and Lagrangian assessments of distribution could be conducted before, during, and after mid-frequency sonar training exercises.

Potential methodologies are described briefly below. Most in situ work on acoustic avoidance response in fish has focused on the potential effects of air guns, dam turbines, or boat noise. These studies may need to be extended to examine the potential effects of mid-frequency sonar off the North Carolina coast.

- Measurements of catch rates for commercially and recreationally important species (Lucas and Baras 2000). For example, seismic air guns were observed to reduce catch rates of cod (*Gadus Morhua*) and haddock (*Melanogrammus aeglefinus*) at feeding grounds (Engås et al.1996). Similar research approaches could help to answer questions regarding the effects of mid-frequency sonar on catch rates of species of commercial and recreational interest.

- Monitor changes in commercial and recreational landings. It might be possible to determine whether activities in the proposed USWTR will affect landings (relative to effort) by examining existing state and federal monitoring programs. Considerable care would have to be given to potential confounding effects caused by other factors.

- Observations of fine-scale behavioral and migration changes. Satellite-linked and archival pop-up tags can be used to measure movement and migratory patterns of species such as Atlantic bluefin tuna, *Thunnus thynnus* (Block et al. 2001). This technology could potentially be applied to large-bodied fish species that occur in and around the proposed USWTR to understand the effects of mid-frequency sonar on their movements. More traditional sonic tracking techniques could be used for assessment of fine-scale changes in behavior and short-term responses to exposure to mid-frequency sonar.

Literature cited

Block BA, Dewar H, Blackwell SB, Williams TD, Prince ED, Farwell CJ, Boustany A, Teo SLH, Seitz A, Walli A, et al. (2001) Migratory movements, depth preferences, and thermal biology of Atlantic bluefin tuna. *Science* 293:1310–1314.

Engås, A., S. Løkkeborg, E. Ona, and A. V. Soldal. 1996. Effects of seismic shooting on local abundance and catch rates of cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*). Canadian Journal of Fisheries and Aquatic Sciences 53:2238-2249.

Hastings, M.C., Popper, A.N., Finneran, J.J. and Lanford, P.J. 1996. Effects of low-frequency underwater sound on hair cells of the inner ear and lateral line of the teleost fish *Astronotus ocellatus*. Journal of the Acoustical Society of America 99(3): 17591766.

Lucas, M. C., Baras, E. 2000. Methods for studying spatial behaviour of freshwater fishes in the natural environment. Fish and Fisheries 1: 283-316

Mann, D.A., Higgs, D.M., Tavogla, W.N., Souza, M.J., Popper, A.N. 2001. Ultrasound detection by clupeiform fishes. J Acoust Soc Am 109: 3049-3054.

Mann, D.A., Popper, A.N., Wilson, B. 2005. Pacific herring hearing does not include ultrasound. Biol. Lett. 1: 158-161.

Scholik, A.R. and Yan, H.Y. 2002. Effects of boat engine noise on the auditory sensitivity of the fathead minnow, *Pimephales promelas*. Environmental Biology of Fishes 63: 203-209.

Turnpenny, A.W.H. & Nedwell, J.R., 1994. The effects on marine fish, diving mammals and birds of underwater sound generated by seismic surveys. Report to the UK Offshore Operators Association No. FRR 089/94.

Relevant Literature reviews

- Effects of Anthropogenic Sounds on Fishes, Popper 2003
- Application of Sound and Other Stimuli to Control Fish Behavior, Popper and Carlson 1998
- Evaluation of Evidence for Altered Behavior and Auditory Deficits in Fishes Due to Human-Generated Noise Sources, Edds-Walton and Finneran 2006
- Report on Hydroacoustics, Bioacoustics, and Noise Thresholds for Fish “Best Available Science” Hastings and Popper, 2004
- WORKSHOP ON THE EFFECTS OF ANTHROPOGENIC NOISE IN THE MARINE ENVIRONMENT, Gisiner, 1998

Appendix A. Table summarizing public comments received from Keith Jenkins, Naval Facilities Engineering Command, Atlantic.

Name/Agency	Comment Code	Comment Category	Date	Comments
NMFS	F-09.03	Fish	31-Jan-06	The mid-range sonar could influence the behavior and spawning activities of fish, especially Sciaenidae, Caranigidae, and Scombridae. Research on silver perch indicates that the sound that will be produced by USWTR will cause then to cease spawning choruses.
Seaflow	NGO-17.02	Fish	20-Dec-05	The DEIS is incomplete as it does not address affects on finfish.
Audubon - North Carolina	NGO-23.03	Fish	16-Nov-06	A study should be performed to determine if the sonar mimics predatory mammals, which may disrupt the behavior of finfish by redirecting their travel routes.
Animal Welfare Institute	NGO-32.25	Fish	30-Jan-06	It is inaccurate for the DEIS to use data from captive fish, with respect to sound affects, to extrapolate to estimate sound-modified behavior of wild fish.
Animal Welfare Institute	NGO-32.26	Fish	30-Jan-06	The DEIS is inaccurate in its assertion that non-impulsive noise can kill fish, as one study suggests that it can.
Int.Ocean Noise Coalition	NGO-40.004	Fish	29-Jan-06	The DEIS did not adequately address impacts to finfish, as cited studies pertained to captive fish being exposed to sound sources other than mid-frequency radar.
Int.Ocean Noise Coalition	NGO-40.005	Fish	29-Jan-06	The DEIS does not indicate if cited studies with respect to finfish impacts measures stress hormones, long-term reproductive success, assessment of growth rates.
Int.Ocean Noise Coalition	NGO-40.006	Fish	29-Jan-06	The DEIS is inaccurate in its assertion that non-impulsive noise can kill fish, as one study (Turnpenny, 2004) suggests that it can.
Int.Ocean Noise Coalition	NGO-40.007	Fish	29-Jan-06	The DEIS does not address the effects on fish of masking, stress, and the avoidance of important areas associated with past painful noise events.

Name/Agency	Comment Code	Comment Category	Date	Comments
Int.Ocean Noise Coalition	NGO-40.073	Fish	29-Jan-06	The DEIS needs to provide an explanation why the implications of Turnpenny et al's (1994) research showing fish mortality from non-impulsive acoustic sources is ignored in this DEIS.
Int.Ocean Noise Coalition	NGO-40.097	Fish	29-Jan-06	The DEIS needs to provide evidence that significant hearing threshold shifts do not lead to biologically significant behavioral disruptions in fish.
Environmental Defense	NGO-42.11	Fish	30-Jan-06	The DEIS does not provide supporting data for the conclusion that no significant impacts would occur to fish, or that any change in behavior would be brief and not biologically significant.
Environmental Defense	NGO-42.12	Fish	30-Jan-06	There is anecdotal information from fisherman that naval operations have impacted fishing tournaments, nor does it appear that the Navy has contacted the appropriate sources with respect to the bluefin tuna, which is under a rebuilding plan pursuant to the requirements of the Atlantic Tunas Convention Act.
Pamlico Tar River Foundation	NGO-44.03	Fish	23-Jan-06	The DEIS does not adequately address sonar impacts to finfish.
Discovery Diving Co, Inc.	NGO-47.07	Fish	30-Jan-06	What impacts will the range have on pelagic finfish?
International Ocean Noise Coalition	NGO-49.06	Fish	20-Jan-06	Declines in fish catches after the use of intense acoustic activities suggests that the project will effect finfish populations.
New York Whale and Dolphin Action League	NGO-50.07	Fish	28-Jan-06	The DEIS indicates the range would not impact the fish or their habitat, which is contradictory to the NC Dept of Marine Fisheries position regarding sonar usage.
NRDC	NGO-63.008	Fish	13-Jan-06	It ignores most of the scientific literature demonstrating the impacts of ocean noise on fish and commercial fisheries, and understates the project's potential impacts on fragile hard bottom habitat.

Name/Agency	Comment Code	Comment Category	Date	Comments
NRDC	NGO-63.109	Fish	13-Jan-06	Very little of the scientific literature on acoustic impacts on fish is referenced in the DEIS. Instead, the Navy's analysis is qualitative and cursory, containing no reference to the literature on hearing damage, mortality, and large-scale behavioral change, and no mention of the effect of noise on catch rates.
NRDC	NGO-63.110	Fish	13-Jan-06	The DEIS claims there is no evidence linking non-impulsive sound to mortalities in fish. The statement is untrue, as a few studies have been made of mortality in adults and in eggs and larvae, but even if no such evidence existed, it is not unreasonable based on the broader literature cited above to suppose that non-impulsive sounds might have lethal impacts as well.
NRDC	NGO-63.111	Fish	13-Jan-06	At least one study demonstrates the permanent damage that noise can have on the sensory cells of fish ears - an especially important finding given the importance of snapper, the study's subject, to commercial and recreational fishing around the Navy's preferred site. In any event, it has been noted that even temporary hearing loss could significantly affect a fish's survival.

Name/Agency	Comment Code	Comment Category	Date	Comments
NRDC	NGO-63.112	Fish	13-Jan-06	While admitting that mid-frequency noise can alter behavior, the DEIS argues that fish are less responsive to mid-frequency than to low and high frequency sounds. It improperly relies entirely on two studies on acoustic deterrent devices. Not only do the deterrents featured in the two papers differ enormously from the Navy's mid-frequency tactical sonar, presenting a vary different waver form and operating at a source level literally billions of times less intense; but, in at least one of the studies, it actually altered the behavior of the fish, drawing them into the gillnet for reasons that are not explored. Of course, it is more parsimonious to assume that mid-frequency sound can induce similar kinds of behavioral change.
NRDC	NGO-63.113	Fish	13-Jan-06	The Navy must rigorously analyze the potential for behavioral, auditory, and physiological impacts on fish, including the potential for population-level effects, using models of fish distribution and population structure and conservatively estimating areas of impact from the available literature.
North Carolina Fisheries Association, Inc.	NGO-69-7	Fish	30-Jan-06	We also share the concerns of others who have expressed doubt about the reliability of the data presented in the DEIS with respect to the acoustic effects of sonar on the fishing resources. The jury seems to be out on whether or not significant impact will occur, how long it will last, and what long-term effects will remain and, quite possibly, affect fishing for years to come. It is incumbent upon the Navy to utilize a precautionary approach with this effort that includes better and more reliable data, a further taking into account the uncertainties inherent in an effort of this type, and a willingness to respond to those uncertainties should they prove to be damaging to the fisheries in the proposed testing areas.

Name/Agency	Comment Code	Comment Category	Date	Comments
Acoustic Ecology Institute	NGO-70.12	Fish	26-Jan-06	The DEIS takes a seemingly cavalier attitude toward the acoustic impacts of USWTR activities on local fisheries. While the argument can be made that physiological damage (such as TTS or PTS) is less likely with fish than cetaceans, it is unwarranted leap of faith to then assume that effects are negligible. There have been widespread reports and some well-documented studies indicating that fish tend to avoid or abandon areas where loud human activity is taking place. While the academic studies have tended to focus on seismic surveys, opportunistic reports have linked such impacts to both industrial and Naval activity.
Acoustic Ecology Institute	NGO-70.15	Fish	26-Jan-06	Acoustic impacts not accountable solely by studying ears, or captive animals. Especially as regards fish, the physiological systems that respond to acoustic stimuli are likely not limited to the auditory system; while research into the effects of high-intensity sound waves on these systems is limited, the possibility should be considered in the context of the DEIS. The behavioral responses of fish to sound intrusions is apparently not limited to avoidance; there is some evidence that certain fish will entrench and thereby increase or prolong their exposure to hazardous noise.

Name/Agency	Comment Code	Comment Category	Date	Comments
Sierra Club North Carolina Chapter	NGO-71.59	Fish	30-Jan-06	The Sierra Club does not agree with the statement on page 4.3-77 of the EIS, "significant effects to fish are not anticipated from the installation and operation of the proposed USWTR." Over 800 species of fishes from 109 families worldwide are know to be vocal, and use sound to overcome the problem of living in a dark or visually opaque medium (Rountree, 2002). Many fish species could be disturbed as a result of sonar use. The fish's lateral line system contains diverse receptors that are highly sensitive to various conditions in the water, including sound. How will activities at the USWTR affect forage fish?
Sierra Club North Carolina Chapter	NGO-71.60	Fish	30-Jan-06	Mann et al. (2005) found that Pacific herring had hearing thresholds at lower frequencies (100-5000Hz), which could be relevant to herring found in the USWTR area. Herring are important both as forage fish and commercially. More studies regarding finfish and shell fish, such as this, need to be incorporated into the EIS; very little is cited supporting the Navy's conclusion that there will be minimal effects to fish.
Sierra Club North Carolina Chapter	NGO-71.61	Fish	30-Jan-06	Red drum and croaker, both of which are named for the sounds they make, and sea trout are all very important commercially and recreationally, and the USWTR area may be in the middle of their wintering grounds. Some of these fish may use the area for their spawning grounds as well. The drums in particular may be extremely sensitive to sound since they create drumming sounds to communicate with one another.

Name/Agency	Comment Code	Comment Category	Date	Comments
Sierra Club North Carolina Chapter	NGO-71.62	Fish	30-Jan-06	Many Atlantic sharks are in decline due to overfishing and fishing bycatch; all sharks are highly sensitive to sound. Sandbar sharks migrate through Onslow Bight on their way to mate and give birth in estuarine areas. This species, which has become uncommon, inhabits this area during warmer months. Sand tiger sharks are even rarer and use the wrecks off the NC coast for mating and pupping.
Sierra Club North Carolina Chapter	NGO-71.63	Fish	30-Jan-06	Cownose rays migrate through Onslow Bight on their way to pup in Chesapeake Bay and other larger estuaries. They too are highly sensitive to noise pollution. Clearnose skates use the Onlsow Bight hard bottoms as anchor sites for their eggs. Skates are growing more important in the fishing industry, and like the rays, are important components of a complex ecosystem.
Sierra Club North Carolina Chapter	NGO-71.64	Fish	30-Jan-06	The EIS should thoroughly evaluate the effects of sonar on fish populations off NC including fish larvae.
Sierra Club North Carolina Chapter	NGO-71.65	Fish	30-Jan-06	How will other ecosystem components, such as fish and invertebrates be monitored?
Citizens Opposing Active Sonar Threats	NGO-74.08	Fish	1/20/2006	How can the results of these few limited fish studies (cited in the DEIS) be applied to all of the different fish species, who will be impacted by these sonars in the wild?
Citizens Opposing Active Sonar Threats	NGO-74.09	Fish	1/20/2006	What does the DEIS mean when it states that the threshold shifts (in fish classified as hearing specialists) are temporary and it is not evident that they lead to any long term behavioral disruptions in fish that are biologically significant? Is in not possible that hearing loss would result in an inability to locate food resources and/or evade predators?

Name/Agency	Comment Code	Comment Category	Date	Comments
Seaflow	NGO-76.11	Fish	1/24/2006	The executive summary Section ES 5.3, states that there is "no information available that suggests that exposure to non-impulsive acoustic sound sources results in fish mortality." The absence of information does not imply an absence of harm. Moreover, the document even identifies that certain fish are classified as hearing specialists.
Seaflow	NGO-76.13	Fish	1/24/2006	The assumptions used in the DEIS to exclude fish and invertebrates are quite sweeping, and while they may seem plausible in the context of human experience and human priorities, they may not reflect the priorities and "experience" of the subject organisms.
Seaflow	NGO-76.14	Fish	1/24/2006	There is a common, but erroneous assumption that fish subjected to a threatening noise will swim away from the threat to escape it. While migratory fish may evade threats by swimming away, many fish, especially, sedentary fish, will "entrench" into their safe zone when threatened, and thus prolong their exposure to potentially damaging stimulus.

Name/Agency	Comment Code	Comment Category	Date	Comments
Seaflow	NGO-76.15	Fish	1/24/2006	The audiograms and threshold shift procedures used to determine the acoustical sensitivities of fish in the DEIS' cited studies that justify their exclusion from consideration used either sinusoidal signals or band limited 'pink' noise". While this statement doesn't answer many questions in regard to the impacts of the noise generated by the proposed USWTR project on various fish exposed to the noises of the program, it highlights the fact that the assumptions used to frame their exclusion do not reflect the actual acoustical conditions of the proposed program. This is particularly evident in the fact that some of the proposed acoustical signals will not be sinusoidal, rather some signals will include fast rise times and high "crest factor" which are significantly different from sinusoidal signals. This shortcoming can only be addressed by doing systematic testing on various fish using signals and levels that more closely match the signals proposed for the USWTR.
Southern Environmental Law Center	NGO-78.39	Fish	30-Jan-06	The Navy's conclusions in the DEIS that the use of USWTR will have no impact to fish are unsupported by evidence and references to scientific study. The area in which USWTR would be located is one of the most biologically diverse in the mid-Atlantic. The DEIS fails to note that this region accounts for 50% of the catch of snapper and snowy grouper and that fisheries managers have established protected areas with this area and more are proposed.
Dawson, James	PH-01.12	Fish	15-Nov-05	Fish can hear sound, however, the sonar sound will deafen the fish and then they can not communicate; 235 decibels is extremely loud.

Name/Agency	Comment Code	Comment Category	Date	Comments
Handforth, Mike for Chincoteague Island Charter Boat Association	PH-01.29	Fish	15-Nov-05	The effects of sonar on small fry are not known.
Shute, Joe	PH-02.42	Fish	17-Nov-05	Information needs to be provided concerning the impacts of sonar to pelagic fish. The area of the range includes Swansboro hole and grouper hole; these areas are very important to the offshore charter fleet especially in the spring and late fall.
Shute, Joe	PH-02.45	Fish	17-Nov-05	Tuna and billfish are very susceptible to high frequency sonar; when we are catching a lot of fish, we turn off the depth sounder because it will spook the fish. The Navy's equipment will do the same thing.
Shute, Joe	PH-02.46	Fish	17-Nov-05	When the Navy is conducting exercises, the migrating fish will move further offshore rather then inshore which will move them beyond the area we fish.
Luczkovich, Dr. Joseph	PH-02.56	Fish	17-Nov-05	The DEIS is lacking in the area of the acoustic analysis of fish. The DEIS states that there will be no effect, however, there will be avoidance effects.
Luczkovich, Dr. Joseph	PH-02.57	Fish	17-Nov-05	Fish are subjected to sound by dolphin and other marine mammals, so they are acoustically active and able to hear mid-frequency sonar. Fish stop using mating calls when these sonars are played to them.
Luczkovich, Dr. Joseph	PH-02.60	Fish	17-Nov-05	The dye cast sonar buoys have source levels of 201 dB; that is an extremely high level of sound. This level of sound is higher than fish produce, so the fish will not be able to communicate.
Spruill, John R.	PH-02.63	Fish	17-Nov-05	The disastrous impact of the project to fish such as stripped mullet and menhaden is not addressed in the EIS.

Name/Agency	Comment Code	Comment Category	Date	Comments
Keusenkothen, Mark	PH-02.79	Fish	17-Nov-05	Concerned about the impacts of the sonar to the sharks in the vicinity of the Papoose; it is a place where they mate.
Tulevech, Steven	PH-02.80	Fish	17-Nov-05	Concerned about the effects of sonar on short and long term behavior of migratory fish populations; specifically tuna, dolphin, wahoo and bill fish.
Tulevech, Steven	PH-02.83	Fish	17-Nov-05	More studies are need of the impacts of loud sound on fish to evaluate whether the threshold shifts are temporary.
Luczkovich, Joseph J.	Sc-01.03	Fish	30-Jan-06	The Navy's sonar could mask the fish's sounds and produce changes in the fish behavior. This could possibly occur with all fish species throughout the water column as the Navy's sonar travels large distances.
Luczkovich, Joseph J.	Sc-01.04	Fish	30-Jan-06	Sounds that are loud enough at low frequency could result in the death of fishes.
Luczkovich, Joseph J.	Sc-01.08	Fish	30-Jan-06	The DEIS is deficient in considering impacts to many species of finfish as no behavioral physiological response data have been measured for any of these marine fish. Impacts to finfish will also affect whales that depend on them as a food source.
Luczkovich, Joseph J.	Sc-01.11	Fish	30-Jan-06	Sound producing and hearing specialist fishes occur in the study area and will be affected by sounds from active sonar.
Luczkovich, Joseph J.	Sc-01.13	Fish	30-Jan-06	What are the acoustic effects on essential fish habitat and has the Navy considered the impact of sound on fish spawning activities in the project area?
Luczkovich, Joseph J.	Sc-01.17	Fish	30-Jan-06	The sound of a helicopter could interfere and/or mask the sounds of the silver perch and other Scleanidae and subsequently affect whale foraging and fishes near the surface.
Luczkovich, Joseph J.	Sc-01.18	Fish	30-Jan-06	On Pg 4.3-77 no consideration has been given to the sublethal behavioral responses of fishes to mid-frequency sonar. Acoustically mediated predator-prey and mating interactions are likely to be affected by Navy sonar.

Name/Agency	Comment Code	Comment Category	Date	Comments
Mann, David A.	Sc-02.04	Fish	2-Nov-05	There is insufficient data to determine sonar acoustical impacts to fish as no studies have tested sound levels near those that are to be produced by the sonar. However, it is possible that fishes could detect sonar sound at higher levels.

Initial Distribution List

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